INTENSITY OF PRECIPITATION.

The intensity, or rate, of rainfall varies from zero up to several inches per hour, and, like the strength of the wind, has been popularly divided into several, more or less definite, grades. Most of these, together with the roughly averaged values they imply, are given in the accompanying table.

Precipitation values.

Popular name.	Precipitation intensity, mm. per hour.	Milligrams liquid water per liter of air.	Velocity of fall, meters per second.	Height of cloud, meters above surface.
Clear	0.00	0.00		
Fog	Trace.	0.60	0.003	0
Mist	0.05	5.55	0.25	100
Drizzle	0.25	9.26	0.75	200
Light rain	1.00	13.89	2.00	600
Moderate rain	4.00	27.78	4.00	600
Heavy rain	15.00	83.33	5.00	1,000
Excessive rain	40.00	185.19	6.00	1,200
Cloud-burst	100.00	540.14	7.00	1,200

—*W. J. Humphreys.*

THE WATER CONTENTS OF THE ATMOSPHERE IN RELATION TO HEAVY RAINFALLS.

W. H. Dines has published in the October, 1918, number of the Symons's Meteorological Magazine, a summary of the usual water contents of the atmosphere in western Europe, as determined by the humidity records of 250 registering balloons.

Mr. Dines says:

In the winter the total equivalent rainfall is about 0.40 in., with a range from 0.25 in. to 0.80 in.; in summer the mean is about 0.80 in., with a range from 0.50 in. to 1.50 in. The amount seems to depend chiefly on the temperature and but little on anything else, i. e., if the air is warm there is almost certain to be plenty of moisture and conversely. Practically all the water is contained in the first few kilometers.

These amounts, which would be precipitated if all the moisture present in the atmosphere over a place were condensed, are small relative to those which might result from the inflow of moisture which occurs in the usual convergence of winds in a cyclone. Taking as an example a circular area of 100 kilometers radius, a wind 500 meters deep and having an inflowing component of 10 meters per second would bring in the course of 24 hours sufficient moisture to produce about 8.6 inches (220 mm.) if the temperature were 80° F., 6.6 inches (160 mm.) at 70° F., 3.2 inches (80 mm.) at 50° F., and 1.5 inches (40 mm.) at 30° F. If the circular area were 100 miles in radius and if the inflowing component of the wind were 10 miles per hour, these values would be about quartered. The actual rainfalls would be less, for some of the moisture remains when the air flows away from the area aloft. If the air should be cooled 30° F., as it would in ascending about 2 miles, the precipitation would be about a third less. Since the air which goes into a cyclone does not rise uniformly about the center, the rainfall rate may easily be doubled over considerable areas, at the expense of that over other areas. If a cyclone, however, is moving, this difference in rate might not show in the distribution of total rainfall.—*C. F. B.*

PANAMA THUNDERSTORMS.

By H. G. CORNTHWAITE, Asst. Chief Hydrographer.

[Dated: Balboa Heights, C. Z., October, 8, 1919.]

SYNOPSIS: Thunderstorms in Panama are of frequent occurrence during the eight rainy-season months. More occur over the interior than along either coast, and generally more occur in the afternoon than during the night or early morning.

Thunderstorms are more numerous in Panama than anywhere in the United States, averaging from 100 to 140 per year, but the total loss of life and property damage is relatively less in Panama than in many sections of the United States, probably due to (1) electric discharges between clouds, failing to reach the earth, (2) numerous uninhabited hilltops serving as conductors and protecting the inhabited valleys, and (3) atmospheric conditions favorable for ready interchange of electric currents, tending to prevent the accumulation of powerful electric stresses or differences of potential.

INTRODUCTION.

Thunderstorms are of frequent occurrence in most tropical and equatorial regions of heavy rainfalls. In Panama the curves of thunderstorm frequency follow fairly closely the curves of average monthly rainfall, but August is generally the month of maximum thunderstorm frequency while May and November are the months of heaviest rainfall. There is a marked decrease in thunderstorms in November and December due to a decrease in the number of afternoon convective showers, yet November is usually the *rainiest* month of the year.

The following table shows the yearly average number of thunderstorm days at stations in the Canal Zone, compared with selected stations in the United States:

Station.	Location.	Approximate elevation.	Years of record.	Thunderstorm days each year.
		Feet.		
Colon	Atlantic coast	10	11	106
Culebra	Continental Divide	400	7	137
Balboa Heights	Pacific coast	100	13	119
Tampa, Fla	Gulf coast	67	10	94
Santa Fe, N. Mex	Rocky Mountains	7,013	10	73
Chicago, Ill	Great Lakes	595	10	40
New York City	Atlantic coast	314	10	28
San Francisco	Pacific coast	155	10	1

From an inspection of the accompanying fig. 4 it will be seen that Panama thunderstorms are most numerous in the interior near the Continental Divide and fewest along the Atlantic coast.

HOURLY DISTRIBUTION OF THUNDERSTORMS.

Sufficient data are not available to show accurately the curves of hourly distribution of thunderstorms in Panama, but in a general way from 75 per cent to 80 per cent of all thunderstorms occur in the daytime on the Pacific coast and over the interior, while along the Atlantic coast nearly half of the thunderstorms occur during the night or early morning. The reason for this difference in thunderstorm distribution is to be found in the character of prevailing rainstorms. On the Pacific coast and over the interior most of the rains are afternoon local showers of convective origin, usually accompanied by thunder and lightning, while along the Atlantic coast the climate more closely resembles the marine type and much of the rainfall comes in the form of general storms of wider extent,